

Curriculum Vitae

RESEARCH SUMMARY:

My research focuses on the analysis of current and future observations of exoplanets, planets outside our solar-system, to understand the physics and the chemistry of their atmospheres. Using data-oriented techniques, I have characterised many planets observed with the Hubble and Spitzer Space Telescopes, ranging from the temperate super-Earth LHS-1140b to the extremely-hot Jupiter KELT-9b. I have pioneered in the development of tools (*TauREx3* and *Alfnoor*) adapted to the analysis of large populations of atmospheres and the extraction of their 3D nature from challenging phase-curve observations. I also used those tools to evaluate the performances of next generation telescopes such as ESA Ariel and NASA/ESA JWST in answering some of the major questions of the field. My work is showing the importance of cross-disciplinary approaches in understanding exoplanetary atmospheres.

CURRENT POSITION(S):

2021 Dec – 2022 Mar: **Postdoctoral Fellow for Research in Japan** (JSPS fellowship)
Division of Science, National Astronomical Observatory of Japan (Japan)

2021 – Current: **Postdoctoral Research Fellow**
Department of Physics and Astronomy, University College London (UK)

Leadership roles: Coordinator of the Spectral Retrieval working group for the ESA Ariel Mission.
Developer of the *TauREx* and *Alfnoor* exoplanet suites (more than 5000 downloads).
Co-PI HST Proposal 16457 (8 orbits) and external reviewer of HST Cycle 29.
Founder of the UCT collaboration between UCL and the Tokyo Univ. exoplanet groups.
Project leader “Towards population studies of exoplanetary atmospheres”.
Project leader “Planetary atmospheres are not 1D”.
Reviewer: Experimental Astronomy, Astrophysics and Space Science.

Press articles: The Conversation: “How can some planets be hotter than stars?”.
Science & Vie: “Le mystère des planètes vaporeuses”.
All About Space Magazine: “What are hot-Jupiters?”.

EDUCATION:

- 2018–2021: **PhD in Astrophysics** – *University College London* (UK) – Title: Next generation techniques to characterise exoplanetary atmospheres – Supervisor: Prof. Giovanna Tinetti. Thesis finished in 2 years (1.5 years ahead of schedule).
- 2017–2018: **Master (Part III) in Applied Mathematics** – *University of Cambridge* (UK) – E.M. Burnett prize for excellent results.
- 2015–2016: **Master (MSc) in Environmental Technology** – *Imperial College London* (UK) – Grade: Merit
- 2013–2016: **Master (MEng) in General Engineering** – *Ecole des Mines Douai* (FRA) – Ranked top 1%.
- 2010–2013: **CPGE: Equiv. Bachelor Degree in Mathematics/Physics** – *Lycée Daudet* (FRA) – Grade: A

OTHER PROFESSIONAL EXPERIENCES:

- 2018 Sep: **ESA Ladybird Guide to Operation Spacecraft training course** (Libramont, BE):
1-week course on spacecraft operations, learning through practical examples. Simulation of a spacecraft failure.
- 2016 Oct – 2017 Sep: **Consultant in IT at Wavestone** (Paris, FRA)
Assisting in designing the new IT system of Alstom by providing cybersecurity advices, assessing IT operations (flow openings, VPN configurations, security exceptions) and more generally by contributing to their IT migration.

- 2015 Nov – 2016 Feb: **Freelance Consultant in Aerospace at OutSmart Insights Ltd** (London, UK)
Technology scanning and advices for an aerospace company (BAE Systems). Identification of key technologies, their applications, their Technology Readiness Level (TRL) and their patent for jet aircrafts.
- 2015 May–Sep: **Internship at TOTAL SA. Study of R&D localization** (Pau, FRA)
Assistance to TOTAL's strategy of R&D reorganisation by comparing the R&D potential of 11 countries. Use of a multicriteria approach based on analysing reports and conducting interviews with TOTAL's collaborators.

PEER-REVIEWED ARTICLES:

Contribution Summary: 8 first author articles, 8 second author articles, and 12 co-authored works published in high-impact journals from 2019 to Present (ADS researcher h-index: 10).

- [1] **Changeat** et al. (2021): An exploration of model degeneracies with a unified phase curve retrieval analysis: The light and dark sides of WASP-43 b, *ApJ*, 913, 73. doi:10.3847/1538-4357/abf2bb.
- [2] **Changeat** and Edwards (2021): The Hubble WFC3 Emission Spectrum of the Extremely-Hot Jupiter, KELT-9b, *ApJL*, 907, L22. doi:10.3847/2041-8213/abd84f.
- [3] **Changeat**, et al. (2021): Disentangling Atmospheric Compositions of K2-18 b with Next Generation Facilities, *Exp. Astron. Ariel Special Edition*. doi: 0.1007/s10686-021-09794-w.
- [4] **Changeat**, et al. (2020): KELT-11b: Abundances of water and constraints on carbon-bearing molecules from the Hubble transmission spectrum, *AJ*, 160, 260. doi:10.3847/1538-3881/abbe12.
- [5] **Changeat** and Al-Refaie (2020): TauREx3 PhaseCurve: A 1.5D model for phase curve description, *ApJ*, 898, 155. doi:10.3847/1538-4357/ab9b82.
- [6] **Changeat**, et al. (2020): Alfnoor: A Retrieval Simulation of the Ariel Target List, *AJ*, 160, 80. doi:10.3847/1538-3881/ab9a53.
- [7] **Changeat**, et al. (2020): Impact of planetary mass uncertainties on exoplanet atmospheric retrievals, *ApJ*, 896, 107. doi:10.3847/1538-4357/ab8f8b.
- [8] **Changeat**, et al. (2020): Towards a more complex description of chemical profiles in exoplanets retrievals: A 2-layer parameterisation, *ApJ*, 886, 39. doi:10.3847/1538-4357/ab4a14.
- [9] Al-Refaie, **Changeat**, et al. (2021): TauREx III: A fast, dynamic and extendable framework for retrievals, *ApJ*, 917, 37. doi: 10.3847/1538-4357/ac0252.
- [10] Tinetti et al. (2021): Ariel: Enabling planetary science across light-years, *Ariel Definition Study Report reviewed by ESA Science Advisory Structure in November 2020*, arXiv:2104.04824.
- [11] Mugnai et al. (2021): ARES V: No Evidence For Molecular Absorption in the HST WFC3 Spectrum of GJ 1132 b, *AJ*, 161, 284. doi:10.3847/1538-3881/abf3c3.
- [12] Ito, **Changeat**, et al. (2021): Detectability of Rocky-Vapour Atmospheres on Super-Earths with Ariel, *Exp. Astron.*, <https://doi.org/10.1007/s10686-020-09693-6>.
- [13] Turrini et al. (2021): Tracing the formation history of giant planets in protoplanetary disks with Carbon, Oxygen, Nitrogen and Sulphur, *ApJ*, 909, 40. doi:10.3847/1538-4357/abd6e5.
- [14] Yip, **Changeat**, et al. (2020): Peeking inside the Black Box: Interpreting Deep Learning Models for Exoplanet Atmospheric Retrievals, *Accepted in ApJ – arXiv:2011.11284*.
- [15] Edwards, **Changeat**, et al. (2020): Hubble WFC3 Spectroscopy of the Habitable-zone Super-Earth LHS 1140 b, *AJ*, 161, 44. doi:10.3847/1538-3881/abc6a5.
- [16] Guilluy et al. (2020): ARES IV: Probing the atmospheres of the two warm small planets HD 106315 c and HD 3167 c with the HST/WFC3 camera, *AJ*, 161, 19. doi:10.3847/1538-3881/abc3c8.
- [17] Yip, **Changeat**, et al. (2020): On the Compatibility of Ground-based and Space-based Data: WASP-96 b, An Example, *AJ*, 161, 4. doi:10.3847/1538-3881/abc179.
- [18] Anisman et al. (2020): WASP-117 b: an eccentric hot-Saturn as a future complex chemistry laboratory, *AJ*, 160, 233. doi:10.3847/1538-3881/abb9b0.
- [19] Edwards, Anisman, **Changeat**, et al. (2020): Original Research By Young Twinkle Students (ORBYTS): Ephemeris Refinement of Transiting Exoplanets II, *RNAAS*, 4, 109. doi:10.3847/2515-5172/aba42b.
- [20] Pluriel et al. (2020): ARES III: Unveiling the Two Faces of KELT-7 b with HST WFC3, *AJ*, 160, 112. doi:10.3847/1538-3881/aba000.

- [21] Skaf et al. (2020): ARES II: Characterising the Hot Jupiters WASP-127 b, WASP-79 b and WASP-62 b with HST, *AJ*, 160, 109. doi:10.3847/1538-3881/ab94a3.
- [22] Edwards, **Changeat**, et al. (2020): ARES I: WASP-76 b, A Tale of Two HST Spectra, *AJ*, 160, 8. doi:10.3847/1538-3881/ab9225.
- [23] Edwards, **Changeat**, et al. (2020): Original Research By Young Twinkle Students (ORBYTS): Ephemeris Refinement of Transiting Exoplanets, *MNRAS*, 504, 4. doi:10.1093/mnras/staa1245.
- [24] Bourgalais, Carrasco, **Changeat**, et al. (2020): Ions in the Thermosphere of Exoplanets: Observable Constraints Revealed by Innovative Laboratory Experiments, *ApJ*, 895, 77. doi:10.3847/1538-4357/ab8e2d.
- [25] Barstow, **Changeat**, et al. (2020): A comparison of exoplanet spectroscopic retrieval tools, *MNRAS*, 493, 4884. doi:10.1093/mnras/staa548.
- [26] Drummond et al. (2020): Implications of three-dimensional chemical transport in hot Jupiter atmospheres: results from a consistently coupled chemistry-radiation-hydrodynamics model, *A&A*, 636, A68. doi:10.1051/0004-6361/201937153.
- [27] Venot et al. (2020): Global Chemistry and Thermal Structure Models for the Hot Jupiter WASP-43b and Predictions for JWST, *ApJ*, 890, 176. doi:10.3847/1538-4357/ab6a94.
- [28] Yip et al. (2020): Pushing the Limits of Exoplanet Discovery via Direct Imaging with Deep Learning, *ECML – PKDD 2019*. doi:10.1007/978-3-030-46133-1_20.

INTERNATIONAL COLLABORATIONS:

- **Flatiron Institute, Simons Foundation** – New York (USA): Collaboration with Prof. J. Cho group as part of the joint-project “Planetary atmospheres are not 1D”.
- **NASA Jet Propulsion Lab (JPL)** – Pasadena (USA): Collaboration with Prof. M. Swain group as part of the Cross-Spec team and the ESA Ariel Mission.
- **Tokyo University** – Tokyo (JP): Collaboration with Prof. M. Ikoma in a number of planetary formation studies and creation of the UCT (University College Tokyo) research group.
- **Institute of Astrophysics Paris (IAP)** – Paris (FR): Collaboration with Prof. J-P. Beaulieu and P. Drossart for the ARES project and schools.
- **Centre à l’Energie Atomique (CEA)** – Paris (FR) : Collaboration with Prof. P-O. Lagage as part of the ESA Ariel mission and the JWST MIRI instrument.
- **Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA)** – Paris (FR) : Collaboration with Dr. O. Venot for the EXACT (EXoplanetary Atmospheric Chemistry at high Temperature) project and in a number of chemistry related studies.
- **Sapienza University** – Rome (IT): Collaboration with Prof. E. Pascale group in the context of ESA Ariel Mission and the development of the *Alfnoor* tool.
- **Italian National Astrophysics Institute (INAF)** – Rome (IT): Collaboration with Prof. D. Turrini to build a bridge between planetary formation and exoplanet atmospheric studies.
- **University of Edinburgh** – Edinburgh (UK): Collaboration between the UCL and Edinburgh exoplanet groups to expand retrieval techniques to directly imaged exoplanets.

SELECTION OF INVITED AND CONFERENCE TALKS:

- Invited talk at the **Tokyo University** (JP) – Jan 2022.
- Invited talk at **NASA Goddard Space Flight Center** (Virtual) – Dec 2021.
- Invited talk to the **Ariel ARES day** (Virtual) – Dec 2020.
- Invited talk at the **Tokyo University** (JP) – Mar 2020.
- Conference talk at the **Rocky Exo-worlds Conference** in Cambridge (UK) – Jan 2020.
- Invited talk at the **Tokyo University** (JP) – Oct 2019.
- Conference talk at the **EPSC-DPS 2019** conference in Lyon (FR) – Sep 2019.
- Invited talk at the **University of California Berkeley** (USA) – Jul 2019.
- Invited talk at the **NASA Jet Propulsion Lab** (USA) – Jul 2019.
- Invited talk at the **California Institute of Technology** (USA) – Jul 2019.

- Conference talks in **about 15 other events**, including ESA Ariel Consortium meetings (Europe locations) – 2018 to Present.

PUBLIC EVENTS:

- Invited public talk for the **Astronomines Conference** (Online) at Ecole des Mines Saint-Etienne – Dec 2020.
- Invited public talks for the **Conférence Astronomie** at Lycée Jacques Prévert and Saint-Christol-les-Ales (3 talks: open to all, reserved for students, for literature students) – Nov 2019.
- Invited public talk for the **Space Cafe** in Tokyo – Oct 2019.

TEACHING:

- **Student Supervision:** Ms. Estelle Janin, Mr. Lorenzo Pica Ciamarra, Ms. Alexandra Thompson, Mr. Luke Keyte, 2019 to Present.
- **Organisation of a TauREx hands-on workshop** for Exosystèmes II in Toulouse – Dec 2021.
- **Teaching to about 20 PhD/PostDocs** at the ARES II Summer School (Organising Committee) – Sep 2021.
- **Teaching to about 20 PhD/PostDocs** the use of atmospheric retrieval tools at the ARES Summer School in Biarritz. This led to 5 co-publications – Sep 2019.
- **Organisation of a TauREx 2h-tutorials** for the Digital Exoplanets conference in Prague – Feb 2019.
- **Marking of coursework and exams** for the UCL Exoplanet course – 2018 to 2019 cohorts.
- **Teaching exoplanet science to high school student** as part of the ORBYTS program. Planification of observations with the LCO and TelescopeLive networks to characterise ephemerids of transiting planets. Two publications – 2018 to 2020.

AWARD AND PRIZES:

- JSPS Short-Term Postdoctoral Research Fellowship at NAOJ in Japan – Apr 2021.
- UKSA Postdoctoral Research Fellowship at University College London – Jan 2021.
- Funding to teach at the Biarritz Summer School from CNES – Sep 2019
- Bursary from NASA/MIT to attend the TESS conference at MIT – Aug 2019.
- Bursary from NASA to attend the Sagan Summer School at Caltech – Aug 2019.
- Grant from UCL (UCL Cities Partnership) for travel to Paris and Rome collaborations – Jul 2019.
- Bursary from Europlanet to participate to the ASES3 Summer School in Vietri – May 2019.
- PhD fellowship for 3.5 years at University College London – Oct 2019.
- Bursary from ESA to attend the Ladybird training course – Oct 2019.
- Prize in recognition of excellent results (E.M. Burnett) from Cambridge University – Oct 2018.
- Bursary from Ecole des Mines to support the double degree with Imperial College London – Dec 2015.

SKILLS AND OTHER INTERESTS:

Languages:

- French: Mother tongue
- English: Fluent

Computer Skills:

- Numerical Modelling (ANSYS, Solidworks)
- Programming (C, Python, Java, HTTP)

Other skills and interests:

- Astrophotography and Telescope observations.
- PPL plane pilot training & Gliding
- Skiing: Competition & teaching (23 years).
- Volleyball: Alès and Douai Clubs (8 years)
- Kitesurfing (10 years)